

3.3.8 Weather - Drought and Effects of Drought

Drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water or soil moisture shortage for some activity, group, or environmental sector. Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.

3.3.8.1 Background

Drought is usually considered relative to some long-term average condition of balance between precipitation and evapo-transpiration perceived as "normal". Drought is related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains.

The effects of drought become apparent with a longer duration because more and more moisture-related activities are affected. Non-irrigated croplands are most susceptible to moisture shortages. Rangeland and irrigated agricultural lands do not feel the effects of drought as quickly as the non-irrigated, cultivated acreage, but their yields can also be greatly reduced due to drought. Reductions in yields due to moisture shortages are often aggravated by wind-induced soil erosion (**Picture 3.8-1**).



Photo 3.8-1 Sand dunes during 2002 drought in eastern Montana.

Source: Montana NRIS (2004).

In periods of severe drought, plant and forest fuel moisture is very low, increasing the potential for devastating wildland and rangeland fires. The most recent extreme fire seasons in 1988, 2000, and 2003 all coincided with sustained drought periods. Under extreme drought conditions, lakes, reservoirs, and rivers can be subject to severe water shortages, impacting irrigation, drinking water, fish populations, and fire suppression water supplies.

An additional hazard resulting from drought conditions is insect infestation. In the Northern Great Plains, rangeland **grasshopper** outbreaks have caused significant damage to the agricultural economy. Grasshopper populations tend to increase with both livestock grazing rates and dry conditions, and they can double, triple, or quadruple with each successive year of drought.

During a severe grasshopper outbreak, grasshoppers often remove more vegetation than cattle in the same pasture. Of the 400 species of grasshoppers in the Western United States, only about two dozen species are actually considered pest species capable of causing significant economic damage and a few species are even considered beneficial because they eat weeds. Grasshoppers are important to the grassland ecology, offering a primary food source for many grassland birds. Sources: NDMC, 2004; Branson, 2002.



Photo 3.8-2 The lesser migratory grasshopper is the most common pest species in the Western United States. Source: Branson, 2002

3.3.8.2 History of Drought and Effects of Drought in Montana

Our perspective of drought and its historic impact on Montana extends back about 100 years. A longer look at the history of climate for the region provides a little better perspective on how the current drought and drought in the 1930s compare. Some of the research suggests the recent drought conditions were minor compared to drought modes that existed prior to 1200 A.D. Paleoclimate research indicates that regular and persistent droughts existed and were specifically pronounced during the years of A.D. 200-370, A.D. 700-850, and A.D. 1000-1200. These were long, sustained dry periods and made the period from A.D. 1200 to the present appear relatively wet (Laird et al., 1996).

A closer focus into the more recent paleoclimate, using tree rings to identify dry periods, shows a much wetter period in the United States over the past 300 years. NOAA researchers reconstructed Palmer Drought Severity Indexes from tree-ring data and found that historic droughts, similar to severity and duration of drought during the 1950s, occurred once or twice a century for the past three centuries in the United States (1860s, 1820s, 1730s). The research also showed that there has not been another drought as extensive and prolonged as the 1930s drought in the past 300 years (NOAA, 2003).

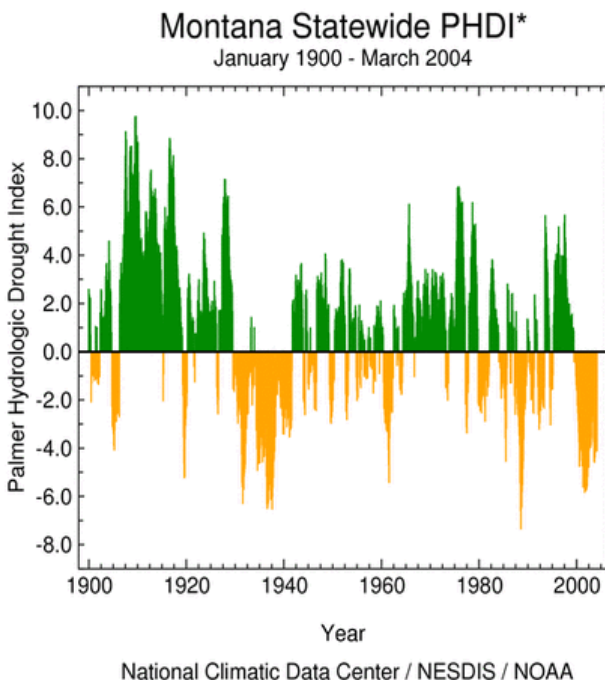
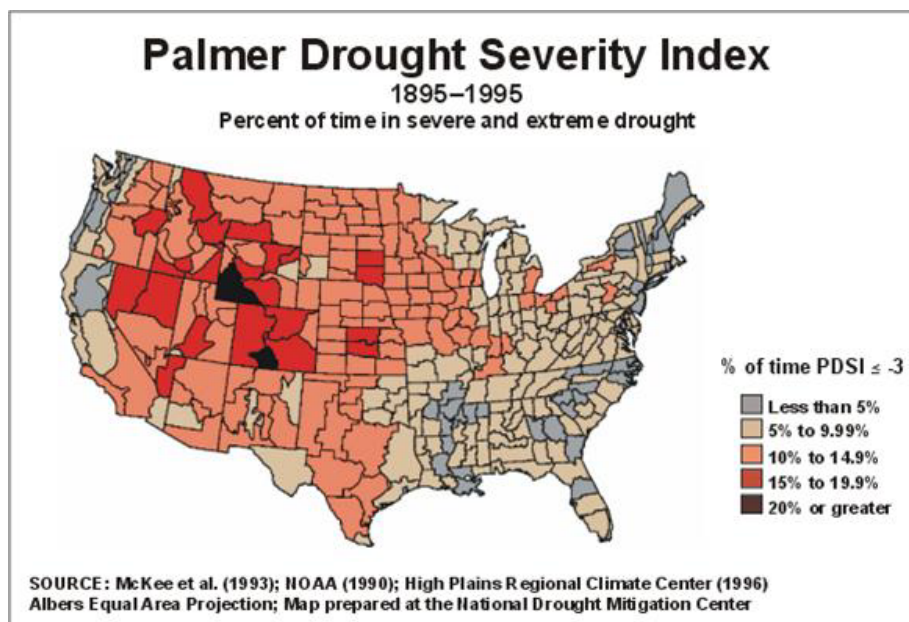


Figure 3.3.8-1 Palmer Hydrologic Drought Index 1900s

In the last 100 years, the first experiences of drought impacts occurred shortly after homesteaders flooded the state. The homestead boom of 1906 through 1918 “busted” when severe drought swept the state from 1917 through 1923. The drought was compounded by plummeting market prices and banks demanding repayments. The out-washing exodus of demoralized homesteaders proved even more rapid than the previous incoming wave of optimistic settlers. Of the estimated 100,000 immigrants who flooded into the state (1906-1918), 65,000 departed between the armistice of World War I (1918) and about 1925. The homestead collapse, among other forces, propelled Montana into a depression from which it did not recover until World War II (Montana Historical Society, 2004).

**Figure 3.3.8-2
Percent of Time in
Severe or Extreme
Drought over 100
Years (1895-1995)**
Based on the Palmer
Drought Severity
Index (NDMC, 2003)



Already reeling from the 1919 drought and agricultural disaster, the Dust Bowl years further impacted agricultural production and economies throughout the state. The period from 1928 through 1939 was the driest in the historic record. The Palmer Hydrologic Drought Index (PHDI) showed the entire state was in a hydrologic deficit for over 10 years. Other sustained dry periods include the middle 1950s, early 1960s, mid-1970s, and the 1980s. The most-recent drought from 2000-2004, suggests the dryness and hydrologic deficit mimics the Dust Bowl years in everything but duration.

Extreme high temperatures, low humidities, wind, rainfall, and snowpack can all contribute to drought conditions. Montana's weather extremes can be a factor in compounding an existing drought problem. In Glendive on July 20, 1893 and in Medicine Lake on July 5, 1937, the temperature reached 117° F. During 1960, the community of Belfry only received 2.97 inches of precipitation, another Montana extreme. Although Montana is typically known for its extreme winter weather, summertime extremes can also have an impact.

Drought and other agricultural disaster declarations in Montana from 1930-2003 are summarized in **Table 3.3.8-2**. Although damage information is incomplete, this table helps illustrate that the four years of drought from 2000-2004 has been one of the most costly in the past 30 years.

Table 3.3.8-2 Montana Drought and other Agricultural Disasters. Sources: MDES, 1998, 2003, 2004d; NOAA, 2004b; NCDC, 2004; Maxim, 2003a, 2003b; US SBA, 2004.

Date	Event	Damages
1930-1938	Dust Bowl	
1938	Grasshopper Infestation affecting 17 counties with populations "between 40 and 500 hoppers per square yard".	\$6,500,000
1956	20 counties applied for Federal disaster aid due to reduced precipitation	
1961	17 counties requested designation as federal disaster areas due to lack of moisture, higher than normal temperatures, and grasshopper infestation.	
August 1961	24 counties applied for federal drought disaster aid.	Federal: \$420,000
1966	Below-normal precipitation for a 10-month period recorded in 10 weather stations across the state.	
August 1975	Grasshopper Infestation, Valley County. Up to 110-120 hoppers per square yard in hay fields. 40,000 acres sprayed.	State: \$60,000 Local: \$60,000
May 1977	Soil damaged by winds in western and southern part of state over a 7-month period.	250,000 acres of farmland damaged
June 1977	Hydroelectric water supplies critical; Governor Judge issued an energy supply alert and ordered 10% reduction in electricity use by state and local governments.	
1980	Record-low precipitation in eastern Montana since 1979. In Richland County alone, 600 of the county's 800 farmers had applied for federal payments for drought. Grasshopper infestations in isolated areas, little wheat planted, large numbers of livestock sold due to hay and water shortages.	Est. economic loss: \$380,000,000
1981	Drought starting in 1979 continued. March snow pack 50-60% of normal	
1984	By July, many High-Line cities experiencing water shortages and rationing schedules put into effect. Numerous forest and range fires.	Est. crop losses: \$12,000,000 to \$15,000,000
1985	All 56 counties received disaster declarations for drought during this year. From 1982 to 1985, cattle herds reduced by 1/3. Smallest wheat crop in 45 years. Extended effects of drought: loss of off-farm jobs, closing of implement dealerships and Production Credit Associations.	Est. economic loss: \$3,000,000,000
June 1986	Grasshopper Infestation. Carter, Daniels, Golden Valley, Petroleum, Richland, Roosevelt, Sheridan, Treasure & Wibaux counties.	State: \$350,000 Local: \$350,000
June 1992	Drought Emergency (EO 13-92). All areas of the state, suspend certain regulatory authorities relating to the issuance of beneficial water use permits by DNRC because of drought.	
June 1992	Drought Disaster (EO 14-92). All areas of the state, continue the suspension of certain regulatory authorities relating to the issuance of beneficial water use permits by DNRC because of drought.	
October 1992	Terminating drought disaster (EO 20-92). Executive Order terminating the declaration of disaster ordered in EO 14-92.	
August 1994	Drought emergencies were declared in a number of Montana counties with 83% of the State reported under drought conditions at mid-month. Stress to stream fisheries (low water levels, high temp.); crop yields, wildfires.	
2000	Severe drought and persistent heat causing significant losses to agriculture and related industries	\$4.2 billion in damage/costs and 140 deaths nationwide
2000-2002	The U.S. Department of Agriculture (USDA) issued Natural Disaster Determinations (NDD) for drought for the entire state of Montana for the years 2000, 2001, and 2002. This designation entitled counties to low interest loans for producers, small business administration loans, and an Internal Revenue Service provision deferring capital gains.	
2003	The USDA issued NDD for drought for 35 counties in Montana on December 3, 2003. This designation makes Montana farmers and ranchers eligible for USDA Farm Service Agency (FSA) emergency farm loans if they have losses caused by drought in the 2003 crop year.	\$154,012,122 paid by FSA in Montana
2004	The USDA issued NDD for drought for 20 counties in Montana on April 23, 2004. This designation makes Montana farmers and ranchers eligible for USDA Farm Service Agency (FSA) emergency farm loans if they have losses caused by drought in the 2004 crop year.	

The current drought conditions have drawn comparisons to drought in 1930s during the Great Depression and Dust Bowl period. In Montana, the Dust Bowl period lasted about 11 years, 1930-40 (inclusive). Below-normal precipitation was experienced during nearly every year of the Dust Bowl. Additionally, the 1930s were warmer than normal, which, again, exhibits some similarities to our current climate.

At some selected sites around the state, the NWS (2004) added up the amount of "lost" precipitation during the 11 year period, 1930-40, as compared to our current 30 year annual normal precipitation (see **Figure 3.3.8-3**). Similarly, NWS (2004) examined the "lost" precipitation during the last 5 calendar years (1999-2003). For those years, the precipitation deficit is shown in **Fig. 3.3.8-4**.

Figure 3.3.8-3 Precipitation anomalies during 11 years of the Dust Bowl (1930-1940)

Source: NWS, 2004.

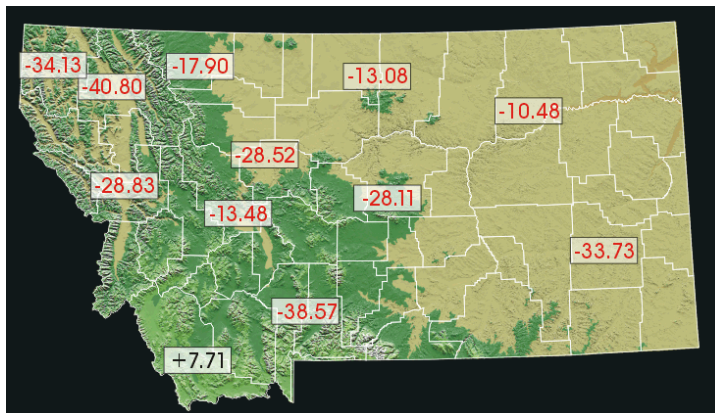
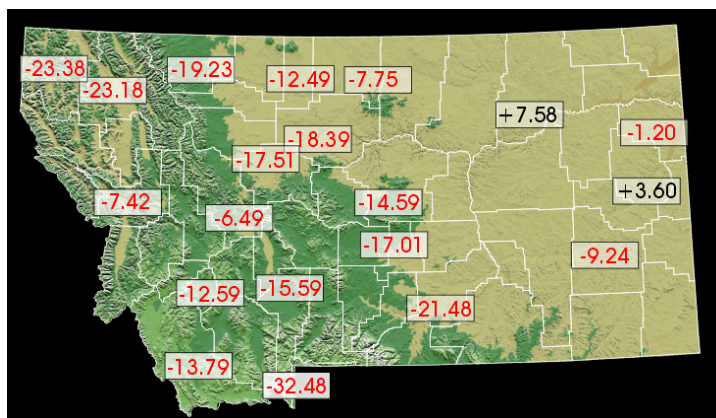


Figure 3.3.8-4 Precipitation anomalies 1999-2003

Source: NWS, 2004.



3.3.8.3 Declared Disasters from Drought and Effects of Drought

Drought disasters are unique; they typically do not require evacuations or constitute an imminent threat to life or property. As a result, disaster declarations and assistance are typically provided by agencies such as the USDA Farm Service Agency (FSA) and Small Business Administration (SBA). There have been no Presidential disaster declarations for drought, except for those related to wildland fires. The declarations at the Federal level have been from the Secretary of Agriculture and are referred to as Natural Disaster Determinations (NDD). NDDs allow various assistance programs, such as the low-interest FSA Emergency Loans to Eligible Producers, and assistance through the Crop Disaster Program, Livestock Compensation Program, and Livestock Indemnity Program, among

others. State disaster declarations and assistance were provided to grasshopper infestations, as shown in **Table 3.3.8-3**.

Table 3.3.8-3 State Disaster Declarations for Grasshopper Infestation. Source: MDES, 2004.

Year	PA No.	Applicant	Local Share	State Share
1975	MT-1-75	Valley County	\$ -	\$ 59,562.00
1985	MT-85-2	Carter County	\$ 12,913.62	\$ 12,912.62
1985	MT-85-3	Judith Basin County	\$ 15,770.00	\$ 15,770.00
1985	MT-85-4	Pondera County	\$ 43,480.00	\$ 43,480.00
1985	MT-85-5	Prairie County	\$ 11,704.18	\$ 11,704.18
1985	MT-85-6	Sheridan County	\$ 112,021.62	\$ 112,020.62
1985	MT-85-7	Wibaux County	\$ 19,507.89	\$ 19,507.89
1986	MT-86-1	Carter County	\$ 14,280.00	\$ 14,280.00
1986	MT-86-2	Daniels County	\$ 56,245.00	\$ 56,245.00
1986	MT-86-3	Golden Valley County	\$ 8,253.00	\$ 8,253.00
1986	MT-86-4	Petroleum County	\$ 9,842.00	\$ 9,842.00
1986	MT-86-5	Richland County	\$ 69,037.50	\$ 69,037.50
1986	MT-86-6	Roosevelt County	\$ 57,176.00	\$ 57,176.00
1986	MT-86-7	Sheridan County	\$ 100,152.50	\$ 100,152.50
1986	MT-86-8	Treasure County	\$ 12,733.00	\$ 12,733.00
1986	MT-86-9	Wibaux County	\$ 22,281.00	\$ 22,281.00

Natural Disaster Determinations (NDD) were made for drought in 2000, 2001, 2002, 2003, and 2004. The NDDs were statewide, except for the determinations in 2003 and 2004, which identified 35 and 20 primary counties, respectively. **Table 3.3.8-4** shows the FSA payments by program for 2003.

Table 3.3.8-4 FSA Payments to Montana Agricultural Producers for Drought, FY 2003 (ending Sept. 3, 2003). Source: USDA FSA, 2004.

USDA Farm Service Agency Program	Payments from USDA
2001/2002 crop year for Crop Disaster Program (CDP)	\$89,833,726
Sugar Beet Disaster Program	\$1,732,248
Apple Market Loss Assistance II and III Programs	\$12,209
2003 Livestock Assistance Program (LAP)	\$14,353,129
Livestock Compensation Program I and II (LCP)	\$35,206,733
Emergency Conservation Program (ECP)	\$3,063,028
Non-insured Crop Disaster Program (NAP)	\$9,811,049
Total	\$154,012,122

Drought has a profound effect on other contributors to the agricultural economy than just producers. The Small Business Administration can make declarations to provide assistance to businesses that are directly related to agricultural production, such as implement dealers and agricultural suppliers. The U.S. Small Business Administration (US SBA 2004) issued the following weather disaster declarations in 2003:

- **SBA Declaration #9Y61 – Drought:** Small businesses in Beaverhead, Gallatin, Madison, and Ravalli Counties were eligible to apply for a low-interest Economic Injury Disaster Loan from the SBA. **Excessive Heat:** Small businesses in Mineral,

Missoula, and Ravalli Counties were eligible to apply for a low-interest Economic Injury Disaster Loan from the SBA.

- **SBA Declaration #9Y72 – Drought:** Small businesses in the entire state were eligible to apply for a low-interest Economic Injury Disaster Loan from the SBA.
- **SBA Declaration #9Y79 for Flooding, Ground Saturation, Storms, Winds, Tornadoes, High Humidity, Dry Conditions, and Severe Temperatures.** Small businesses in Fallon, Richland, Roosevelt, Sheridan, and Wilboux Counties were eligible to apply for a low-interest Economic Injury Disaster Loan from the SBA. These loans were available to small businesses dependent on farmers and ranchers that suffered financial losses that occurred starting April 1, 2003.
- **SBA Declaration #9Y53 for Extreme Heat, High Wind, Severe Storms, Prairie and Forest Fires and Below Normal Precipitation.** Small businesses in Carter and Fallon Counties were eligible to apply for a low-interest Economic Injury Disaster Loan from the SBA. These loans were available to small businesses dependent on farmers and ranchers that suffered financial losses that occurred starting January 1, 2003.

3.3.8.4 Vulnerability to Drought and Effects of Drought

3.3.8.4.1 Statewide Vulnerability to Drought and Effects of Drought

Any place in the state can be considered vulnerable to drought. Weather cycles will dictate the availability of water and the extreme temperatures to exacerbate drought. Vulnerability is related to lack of preparedness. The ability to have adequate stores of water, to change to drought resistant crops, to implement conservation measures during extended dry periods, all helps to reduce negative impacts. Vulnerability is increased when lessons learned during drought are ignored or forgotten following a return to normal weather patterns.

Since Montana's population and water usage is continuing to grow, demand for water is rising at a steady rate. Available supplies have also increased over the years through a variety of structural (dams) and non-structural (conservation) means, but the State's ability to create new levels of supply is marginal. In recent years, demands on water have been increasing faster than supplies, so that tolerance to deal with water shortages is diminishing. The balance between supply and demand is likely to be disrupted more and more frequently, and in the future, water shortages are likely to be more frequent and costly.

The most effective means to assess vulnerability from drought is to determine what areas are exposed economically to the effects of drought. Water shortages force conservation and water use restrictions, can reduce our recreation opportunities, and can increase the threat of wildland and rangeland fire. For many Montana residents, water shortages may impact sectors of our economy, but are seldom disastrous. The major exception is agriculture, and those who directly depend on the agricultural economy. Drought has the most profound impact on growing crops and providing enough feed for livestock.

Counties that have a high dependence on agriculture are reflected in the percentage of personal farm income to total personal income. These counties may be more vulnerable to drought (See **Figure 3.3.8-4**). **Table 3.3.8-5** shows the ten counties that have the highest percentage of farm income to personal income as measured in 1999. The table also

shows the impacts from drought in 2000 and 2001 through the decline of farm personal income.

Table 3.3.8-5 Total Personal and Farm Income by County (1999-2001).
Source: USDC BEA, 2004.

County	1999			2000			2001		
	Personal (\$,000)	Farm (\$,000)	%	Personal (\$,000)	Farm (\$,000)	%	Personal (\$,000)	Farm (\$,000)	%
Petroleum	8,768	2,233	25.47%	7,737	936	12.10%	8,369	1,794	21.44%
McCone	41,459	10,348	24.96%	37,648	5,249	13.94%	35,498	3,072	8.65%
Prairie	27,452	6,636	24.17%	25,666	3,189	12.42%	28,320	4,789	16.91%
Garfield	27,670	6,427	23.23%	25,302	3,207	12.67%	28,178	5,224	18.54%
Daniels	58,766	13,292	22.62%	56,464	8,517	15.08%	52,858	5,219	9.87%
Chouteau	117,675	21,954	18.66%	110,205	9,090	8.25%	110,376	4,274	3.87%
Sheridan	99,208	18,383	18.53%	97,068	12,404	12.78%	95,321	8,034	8.43%
Liberty	44,988	8,091	17.98%	42,982	4,281	9.96%	40,243	1,509	3.75%
Carter	25,416	4,246	16.71%	24,259	2,182	8.99%	27,723	5,216	18.81%
Meagher	40,199	6,126	15.24%	39,555	3,550	8.97%	40,464	5,957	14.72%
Montana	19,405,391	395,739	2.04%	20,743,596	205,413	0.99%	21,769,095	243,338	1.12%

3.3.8.4.2 Review of Potential Losse in Local PDM Plans

Of the 6 counties that have completed Pre-Disaster Mitigation Plans, all identified drought as a hazard, but none identified it as a primary hazard to the county.

3.3.8.4.3 Vulnerability of State Property

Drought disasters impact economies and can threaten timber reserves, through wildland fires and other environmental impacts. State property that could be vulnerable to drought includes leased cropland and state forest property. Leased cropland returns approximately **\$14 million** annually to the state. Timber production from state-owned timber tracts returned **\$7 million** in FY 2003 (DNRC, 2004). The exposure of leased cropland and timber lands is low, as the return from these properties is relatively small.

State-owned facilities are not considered to be vulnerable to drought.

3.3.8.5 Drought and Effects of Drought Data Limitations

Historic information on USDA FSA payments for drought was not available, except for year 2003. This historical information is critical to determine the locations most affected by drought. The effects and time frames of drought are very subtle and sometimes are masked by other economic and weather conditions. Continued documentation of losses attributed to drought will allow the more specificity in the hazard assessment.

3.3.8.6 Drought and Effects of Drought References

Branson, D., 2002. More Grass, Fewer Grasshoppers! USDA-ARS NPARR, 1500 N. Central, Sidney, MT 59270. <http://www.sidney.ars.usda.gov/sidebar/publications.html>

Department of Natural Resources & Conservation (DNRC), 2004. Trust Land Management Division's Trust Land Revenue Records. URL: <http://www.dnrc.state.mt.us/trust/tlmdhome.htm>.

[Laird, K. R.](#), S. C. Fritz, K. A. Maasch, and B. F. Cumming. 1996. Greater drought intensity and frequency before A.D. 1200 in the Northern Great Plains, U.S.A. *Nature* 384:552-554.

Maxim, 2003a. Daniels County Montana Pre-Disaster Mitigation Plan. Prepared For: Daniels County, P.O. Box 247, Scobey, Montana 59263. Prepared By: Maxim Technologies, Inc. September 2003.

http://www.state.mt.us/dma/des/Library/Daniels_County_Plan.pdf

Maxim, 2003b. Valley County Montana Pre-Disaster Mitigation Plan. Prepared For: Valley County, 501 Court Square, Glasgow, Montana. Prepared By: Maxim Technologies, Inc. May 12, 2003.

Montana Disaster and Emergency Services (MDES), 1998. State of Montana Hazard Mitigation Plan. Revised 1998.

Montana Disaster and Emergency Services (MDES), 2003. State of Montana Department of Military Affairs Disaster and Emergency Services Division. Fax to C. Vandam dated 8/6/03.

Montana Disaster and Emergency Services (MDES), 2004a. State of Montana Department of Military Affairs Disaster and Emergency Services Division. E-mail to N. Winslow dated April 1, 2004.

Montana Disaster and Emergency Services (MDES), 2004d. State of Montana Department of Military Affairs Disaster and Emergency Services Division. Correspondence with J. Aber.

Montana Historical Society, 2004. Montana History Website: A Resource for Teachers of Montana History. URL: <http://www.metnet.state.mt.us/teachmthistory/index.html>.
Montana Natural Resource Information System (NRIS), 2004. Drought data and indices. <http://nris.state.mt.us/drought/data/drdata.htm>

National Climatic Data Center (NCDC), 2004. Event Record Details. NOAA. <http://www.ncdc.noaa.gov/oa/ncdc.html>

National Drought Mitigation Center (NDMC), 2003. Historical Maps of the Palmer Drought Index. <http://www.drought.unl.edu/whatis/palmer/pdsihist.htm>

National Drought Mitigation Center (NDMC), 2004. What is Drought? <http://www.drought.unl.edu/whatis/what.htm>

National Oceanic and Atmospheric Administration (NOAA), 2003. North American Drought: A Paleo Perspective. Created by the staff of the NOAA Paleoclimatology Program. URL: http://www.ngdc.noaa.gov/paleo/drought/drght_home.html

National Oceanic and Atmospheric Administration (NOAA), 2004b. National Weather Service, Climate Prediction Center, U.S. Drought Assessment and On-Line Data. http://www.cpc.ncep.noaa.gov/products/expert_assessment/drought_assessment.html and <http://www.ncdc.noaa.gov/oa/climate/climatedata.html>

National Weather Service (NWS), 2004. Billings and Great Falls Weather Forecast Offices. <http://www.wrh.noaa.gov/Billings/questions/q27.shtml> ; and <http://www.wrh.noaa.gov/Greatfalls/tfx.php?TEXT+precipcomps.html>.

US Department of Commerce (USDC BEA), 2004. Regional Economic Information System. Bureau of Economic Analysis. <http://www.bea.doc.gov/>

USDA Farm Service Agency (USDA FSA), 2004. FSA Disaster Program Information from Heidi Brewer [heidi.brewer@MT.usda.gov]. April 2, 2004.

US Small Business Administration (US SBA), 2004. Disaster Updates by State. <http://www.sba.gov/gopher/Disnews/>